IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR U.S. LETTERS PATENT

Title of the Invention:

IMPROVEMENTS IN AND RELATING TO PORTABLE LIQUID DISPENSERS

Inventor:

FRANK JOSEPH PRINEPPI

Attorney Docket Number: 940-001

Stockwell and Associates, PSC
861 Corporate Drive, Suite 201
Lexington, KY 40503
859.223.3400
www.stockwell-law.com

IMPROVEMENTS IN AND RELATING TO PORTABLE LIQUID DISPENSERS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority in prior UK Patent Application Serial Number: 0314887.1, filed on June 26, 2003

FIELD OF THE INVENTION

[0002] This invention relates to portable liquid dispensers of the type including a power source, a pump and a motor for driving the pump, all contained within a single housing and operable to selectively dispense a discrete quantity of a liquid

BACKGROUND OF THE INVENTION

[0003] Portable liquid dispensers are known for dispensing, *e.g.*, medicines, such as insulin, into the body of a recipient, and a system for achieving this is disclosed in US Patent No.: 5,429,602, the disclosure of which is incorporated herein by reference. In that prior art device, a programmable microprocessor is used to perform one or more control functions via the use of a keyboard or similar or automatically via, *e.g.*, a card reader or from an external source via a modem. The present invention is derived from the realisation that such dispenser technology may be adapted to different uses so as to perform tasks that would otherwise be carried out in conventional but substantially different ways.

SUMMARY OF INVENTION

[0004] According to a first aspect of the invention there is provided a battery operated self-contained submersible liquid dispenser for selectively dispensing discrete or pre-selected quantities of a liquid from a remote liquid reservoir. The dispenser comprises a hermetically sealed walled housing containing a peristaltic pump driven either directly or via a speed reduction gear train by an electric motor in response to motor activation signals received from an electric control circuit within the housing. The pump includes a flexible liquid dispensing tube connected to respective liquid inlet and liquid outlet ports extending through the wall of the housing and a pump actuator for forcing liquid received via the liquid inlet port through the tube to the outlet port. A sensor is located on or in the wall of the housing and is connected to the circuit, the sensor being adapted to sense a changed condition from a required parameter external to the housing, *e.g.*, such as the presence or absence of a fluid such as air or water, the circuit thereafter activating the motor and hence the pump to selectively dispense a discrete or pre-selected quantity of the liquid.

[0005] With this arrangement, the liquid dispenser may *e.g.* be connected via the inlet port to a reservoir of the liquid, *e.g.*, such as a cleaning liquid for cleaning the bowl of a toilet. The housing may ordinarily be submerged near to the top of the toilet cistern such that when a changed condition arises, *i.e.*, the absence of water at the sensor due to the toilet being flushed, a discrete amount of the cleaning liquid may then be discharged into the cistern, either immediately or at some timed interval thereafter, or when the cistern fills up again.

[0006] The sensor may conveniently comprise a pair of electrodes, between

which a change in electrical resistivity may be sensed as the water is discharged from the cistern when the toilet is flushed.

[0007] Conveniently, the microprocessor is programmable by means of external signals, such as through a keyboard mounted on or in the wall of the housing. The microprocessor may also include a timer circuit for activating the motor and hence the pump for a preset duration corresponding to a required rate and hence pre-selected quantity of liquid to be dispensed.

[0008] The actuator may conveniently comprise a spoked wheel comprised of a plurality of radially disposed spokes having free ends, the wheel being driven either directly or indirectly via the motor. The free ends of respective adjacent pairs of spokes are adapted to bear directly or indirectly onto the tube at a pre-determined section of the tube to thereby trap therein and between the adjacent spokes a bolus of liquid to be dispensed via the outlet port. As the wheel rotates in response to urging by the motor, the free ends of the spokes push the bolus progressively through the tube and out of the outlet port. In an improvement to this concept, the end of each spoke includes a roller so as to minimize wear and tear on the outside of the tube in this region and to reduce friction, the rollers "pinching" the walls of the tube flat as they roll over the tube.

[0009] In a second aspect of the invention, the liquid dispenser is programmed to dispense liquid repeatedly at timed intervals, subject to the condition sensed by the sensor indicating a required parameter, *e.g.*, such as if the housing is submersed in a liquid or not. This embodiment finds particularly advantageous use as a dispenser for dispensing liquid chemicals at regular intervals into, *e.g.*, a swimming pool where, if the sensed condition outside of the housing is dry, no liquid is dispensed, but if the

dispenser is submerged, *e.g.*, resting at the bottom of the swimming pool, liquid chemicals such as chlorine, salt, etc. may be dispensed at regular intervals, the sensor or another sensor continually monitoring a required parameter of the swimming pool, such as its pH, salinity, etc.

[00010] Other applications for the liquid dispenser of the invention may also be found such as, *e.g.*, an automatic fragrance/deodorizer dispenser, a consumer-programmed automatic plant feeder, and a fish-tan algaecide dispenser in which the user can set up the desired operating interval between delivery and hence make the volume adjustable to thereby deliver a well metered infusion into the fish tank.

[00011] In a further refinement, the control circuit may be pre-programmed during manufacture to perform required tasks and the battery may be built into the housing before it is hermetically sealed, thereby making the dispenser relatively cheap to make such that it may simply be a disposable item once the battery has been exhausted.

[00012] The invention will now be described, by way of example only, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[00013] Figure 1 is a front perspective view of a liquid dispenser in accordance with first and second aspects of the invention,

[00014] Figure2 is a sectional elevation of the liquid dispenser of Figure 1 showing its internal components,

[00015] Figure 3 is a sectional elevation of part of the dispenser of Figure 1,

[00016] Figure 4 is a schematic circuit diagram showing how the invention works in accordance with a first embodiment, and

[00017] Figure 5 is a schematic circuit diagram showing how the invention works in accordance with a second embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00018] Referring firstly to Figures 1 to 3, which show the mechanical arrangement of a liquid dispenser, an hermetically sealed walled housing 1 of part - cylindrical shape contains a motor 2, drivingly connected to a double worm wheel and spur gear speed reduction arrangement shown generally at 3 to a rotatable actuator 4 of a peristaltic pump mechanism shown generally at 5. A pair of batteries 6 (shown in outline only in Figure 2) provide electric power for the motor 2, a printed circuit board 7 connected to it and to a sensor in the form of a pair of electrodes 8 extending through the housing 1.

[00019] As can be seen more clearly with reference to Figure 3, the peristaltic pump mechanism also includes a flexible tube 9, such as of silicone, which bears against the part cylindrical inner wall 1a of the housing 1 and each end thereof is connected to respective inlet and outlet ports in the shape of spigots 10, 11 to allow liquid within the tube 9 to be drawn into it via the inlet port 10 and expelled via the outlet port 11.

[00020] The pump actuator 4 has four radially disposed spokes or arms 12 carrying respective rollers 13 which bear against the flexible tube 9 such that upon rotation of the actuator in the direction arrowed adjacent pairs of rollers 13 trap therebetween, in use, a bolus of liquid until such is forced out through the outlet port 11 but without such liquid ever entering the hermetically sealed interior of the housing 1 other than to pass through the tube 9.

[00021] As will be appreciated, because the actuator 4 is connected to the drive

shaft of the motor 2 via the worm and spur gear speed reduction arrangement 3, using a worm gear connected to the drive shaft of the motor to drive a spur gear mounted for rotation with another worm gear in mesh with a second spur gear mounted for rotation with the actuator 4, the combined effect of the gearing means that rotation in the opposite direction of the actuator 4 is effectively impossible so that the combination of gearing and actuator 3 essentially acts as a one way valve mechanism for the tube 9 which, in turn, ensures that liquid pushed out of the tube 9 through the outlet port 11 cannot thereafter return. Also, when the motor 2 stops the actuator 4 effectively locks-up such that, depending upon its rotational position within the housing 1, there are always at least two spokes 12 and respective rollers 13 pressing against the outer wall of the tube 9 to prevent escape or ingress of liquid from or to the reservoir (not shown) to which the inlet port 10 of the dispenser is attached. Such reservoir may conveniently be vented to allow ingress of air and hence escape of liquid when the pump 5 is activated by the motor 2, or the reservoir may be collapsible, the torque generated by the motor 2 and drive train 5 being sufficient to cause the liquid in the reservoir to be sucked out of it until empty.

[00022] Turning now to Figure 4, there is shown a schematic circuit diagram showing how a first embodiment of the invention operates. In this embodiment the liquid dispenser produces a single pumping cycle per activation when an activation event occurs which is detected by the electrodes 8. This could typically be a change from a wet state corresponding to the electrodes being submerged, such as in a toilet cistern, to a dry state when the cistern has been flushed, at which point a metered infusion of e.g. a disinfectant is then released into the cistern when a change in electrical resistivity is detected between the electrodes 8. This change is

detected by the electrodes 8 and the signal is then amplified and processed via an amplifier and signal conditioner circuit 14 which produces a single pulse "A" which activates a duration time circuit 15 for determining how long a motor driver circuit 16 activates the motor 2 and hence the peristaltic pump 5. The duration timer 15 may be factory preset through the use of attendant jumper straps shown generally at 17, although it will be understood that other timing circuits may be used, such as through the use of a decade switchbank or even a simple analogue R-C timing circuit. The embodiment shown in Figure 4 is, however, particularly simple to adopt and lends itself to mass production and hence relatively inexpensive manufacture aimed especially but not necessarily, at the disposable market.

[00023] Turning now to the more sophisticated circuit shown in Figure 5, this can be used to provide activation of the motor 2 and hence pump 5 at regular intervals via a separate pre-set interval timer circuit 18 connected via and gate 19. This circuit is designed for use when the electrodes 8 are normally submerged, such as where the liquid dispenser is for dispensing liquid chemicals at regular intervals in e.g. a swimming pool. The amplifier and signal conditioner circuit 14a provide a steady state signal "B" to the gate 19 to signal the electrodes 8 are submerged and at regular intervals, pre-set via the jumper straps 17a, a "duration elapsed" pulse is then sent to the second input terminal of the gate 19, producing a signal in combination with the steady state signal from the amplifier and signal conditioner 14a which triggers the duration timer 15 which, in turn, operates the motor driver circuit 16 and hence motor 2 for the duration specified by the pre-set jumper straps 17. If the electrodes 8 are taken out the water the change of resistivity is sensed by the amplifier and signal conditioner 14a which then shuts off the steady state signal

until the electrodes 8 are submerged again, effectively switching off the circuit, the programmable interval timer 18 thereafter being unable to send a signal to the duration timer 15 through the gate 19. Again, it will be appreciated that the duration timer 15 and programmable interval timer 18 may use instead of jumper straps 17, 17a, *e.g.*, a decade switchbank or a simple analogue R-C timing circuit.

[00024] Reverting to Figure 1, it is envisaged that, depending upon the sophistication of the circuitry and the intended use of the liquid dispenser, digital readout may be provided via a digital display facility 20 using, *e.g.*, an LCD readout, some or all of the circuits may be externally programmable through the use of a keypad 21 and a mode select function 22 may also be used, particularly where, *e.g.*, the liquid dispenser is to be used in variable circumstances, such as in horticulture for, *e.g.*, slow release of fertiliser to suit the particular circumstances in terms of location, type of plant and ambient conditions.

[00025] Because the liquid dispenser uses a peristaltic pump it can be manufactured as a hermetically sealed unit which, as aforesaid, lends itself to the mass market and a multitude of uses where accurate liquid metering is required in response to or dependent upon a sensed condition as described above. A further advantage of using a peristaltic pump is that it is able to self-prime and can be used submerged in another liquid whilst at the same time resisting back-flow leakage. Hence, highly concentrated liquids to be dispensed by the device, which would or could cause environmental or other problems to occur in the event of too great a dose being allowed into the environment, can still be safely connected upstream of the pump without the need for separate control valves or taps.